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Naval Aerospace Medical Research Laboratory
Pensacola, Florida

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13. ABSTRACT

A recurring problem in naval aviation has been the lack of adequate criteria for pilot performance in fleet-type aircraft. In a previous investigation, an attempt was made to isolate the most critical skills and procedures within each of the stages comprising East Coast replacement air group (RAG) training in the F-4 aircraft. The present investigation attempted to replicate these findings from the East Coast RAG with data obtained from the West Coast RAG squadron

For each of the stages analyzed in the East Coast RAG squadron, a small set of graded items was selected on the basis that they could adequately discriminate among replacement pilots according to their final RAG grade. The resulting set of items was found to be highly predictive of both the stage grade from which they were obtained and the final RAG grade. Data were obtained from the West Coast RAG squadron in an attempt to replicate these findings. For the items common to both squadrons, a multiple R of .852 was obtained for the East Coast sample using the final RAG grade as the criterion. Using the beta weights obtained from the East Coast sample, predictions were derived for pilots in the West Coast sample. The resulting correlation between predicted and observed RAG grades was .776.

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INTRODUCTION

At present the naval aviation training flight syllabus consists of four phases: primary, basic, advanced, and the replacement air group (RAG). The first three of these are considered the undergraduate level of training. Upon completion of the advanced phase, the student pilot is awarded his wings and is designated a naval aviator. The RAG is the postgraduate phase of training wherein the student pilot is first introduced to the operations of a fleet-type aircraft. Upon completion of this phase, he is assigned to a fleet squadron.

Most research in naval aviation has been devoted to the isolation of skills and the prediction of student pilot success at the undergraduate levels of training. The success of such efforts is well documented. Nevertheless, the fact remains that a naval aviator is trained to become an integral part of an operational fleet squadron. The ultimate criterion for pilot performance must necessarily result from the manner in which he fulfills the mission objectives for his particular aircraft. The development of a criterion for fleet performance remains a pressing problem--one which is the focus of the present research effort.

Several attempts have been made to develop criterion measures for certain fleet operations. Using an index derived from the arrestment wire engaged, Brictson, Burger, and Kennedy (1) reported a regression model in which altitude error and sink rate were the best predictors of the quality of night carrier landings. In a later study, Brictson, Burger, and Gallagher (2) reported that certain selection test scores and stage grades during training were significantly related to the quality of carrier landings as measured by a number of objective indices. While proficiency in carrier landings lends itself to some degree of objectivity, such is simply not the case for other operations. Consequently, the researcher must rely upon subjective measures of performance. Despite the inherent problems associated with the use of ratings, they are often the only measures which are available. Interestingly enough, the study of Brictson et al (1) reports measures derived from the subjective estimates of the LSO (landing signal officer) to be highly correlated with objective estimates derived from a weighted combination of wave-offs, bolters, and the particular arrestment wire engaged. Such evidence suggests that reliable information can be obtained through the use of such subjective indices.

Developing a criterion for pilot performance across all aircraft communities is a formidable task due to differences in mission orientation. For this reason it was decided to limit the scope of the present research effort to only one group--the F-4 fighter community. The RAG seemed to be a fertile area for

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investigation due to its similarity to actual fleet operations. It was reasoned that the skills required for the successful completion of this phase of training should best reflect those required in the fleet.

RAG training in the F-4 aircraft is broken down into a series of stages. Within each stage, the replacement pilot is expected to demonstrate proficiency in the performance of a wide variety of skills and procedures. It is from the ratings which he receives on each of these items that his stage grades are determined. It seems reasonable that within each stage, certain of these skills and procedures should be of greater importance than others. It should be possible to isolate a small set of "critical" items which would discriminate among replacement pilots of differing ability levels. Such skills, it is contended, should form the basis upon which an adequate fleet performance measure might be constructed.

Shannon, Waag, and Ferguson (3) attempted such an item analysis for each of the stages of F-4 training at VF-101, the East Coast RAG squadron. For each of the stages analyzed, a small set of graded items was selected on the basis that they could adequately discriminate among replacement pilots according to their final RAG grade. A series of regression analyses revealed these isolated items to be highly predictive of both the stage grades from which they were obtained and the final RAG grade. The usefulness of such an approach is demonstrated in a later study by Shannon and Waag (4) in which these isolated items were found to be highly predictive of accidents/incidents despite the fact that the assigned grades were not.

The authors contend that such "critical" items isolated in this manner should form the basis from which an adequate measure of fleet performance might be developed. The purpose of the present investigation was to replicate the findings of the previous investigation with data obtained from VF-121, the F-4 West Coast RAG squadron. In the event similar results were obtained, strong support would be provided to the approach undertaken.

PROCEDURE

The sample group consisted of 59 replacement pilots assigned to VF-121, the West Coast squadron for RAG training in the F-4 aircraft between June 1970 and March 1972. During this period the training syllabus consisted of the following stages: Familiarization (PF); Instruments (PI); Weapons Systems (PS); Conventional Weapons (PW); Tactics (PT); and Field Mirror Landing Practice/Carrier Qualification (FMLP/CQ). For 22 of the pilots, no CQ data were

available due to the fact that this stage had just recently been eliminated from the training syllabus. Student flight records were obtained and item analyses performed for each of these stages.

The grading system for the West Coast RAG requires the instructor to rate the replacement pilot's performance on each skill and procedure as falling within one of five categories: Above Average (AA); Average (A); Below Average (BA); Marginal (M); and Unsatisfactory (U). For each item, a weighted score was derived reflecting the distribution of AA's, BA's, M's, and U's. For each item within a stage, the number of AA's, BA's, M's, and U's were recorded for each replacement pilot across all hops. The number of M's and U's were combined to form a single category. The resulting sums were then weighted by +1, -1, and -2 respectively. These weighted totals were then summed in order to yield an overall score. The resulting item measures were then standardized and transformed to T scores. These derived scores for each of the items were then related to the individual stage grade as well as the final RAG grade in a series of correlational and regression analyses. Only those items were included which had been selected in the previous investigation.

RESULTS

Of the 17 items initially selected from the East Coast sample (3) 14 were found to be graded items for the West Coast sample. For the PF stage, four items were found to be common. These included Headwork, Basic Airwork, Maneuvers, and VFR Glide Slope Control. For the PS stage, three items were common, including Headwork, Basic Airwork, and Altitude Control. For the PT stage, four items were the same. These included Basic Airwork, Aggressiveness, Offensive Air Combat Maneuvering, and Lookout Doctrine. For the FMLP/CQ stages, three items were common, including Glide Slope Control, Speed Control, and Power/Nose Control. In the previous investigation, none of the PI items discriminated among the categories of replacement pilots while the PW data were not available. Consequently, no items were included for these stages.

Correlations were computed between the derived score for each of the 14 items and the stage grade from which they were obtained, as well as the final RAG grade. These results are summarized for both coasts in Table I. Using the final RAG grade as a criterion, a multiple correlation of .852 was obtained for the East Coast sample when all 14 items were entered into the prediction equation. Using the beta weights derived from the resulting equation, predictions were derived for pilots in the West Coast sample. The resulting correlation between predicted and observed RAG grades was .776. A regression analysis

Table I

SUMMARY OF ZERO-ORDER CORRELATIONS BETWEEN

ITEM SCORES AND RAG GRADES

Item	Stage	Correlations With: Stage Grade		Total Grade	
		East	West	East	West
Headwork	PF	.510	.322	.035	.088
Basic Airwork	PF	.699	.526	.276	.250
VFR G/S Control	PF	.653	.733	.244	.746
Maneuvers	PF	.459	.325	.108	.200
Altitude Control	PS	.434	.513	.302	.434
Headwork	PS	.291	.256	.121	.240
Basic Airwork	PS	.255	.343	.255	.279
Aggressiveness	PT	.731	.554	.447	.540
Offensive ACM	PT	.867	.663	.440	.649
Lookout Doctrine	PT	.618	.642	.265	.724
Basic Airwork	PT	.639	.439	.410	.478
Speed Control	FMLP/CQ	.579	.194	.611	.087
Glide Slope Control	FMLP/CQ	.645	.164	.549	.320
Power/Nose Control	FMLP/CQ	.695	.130	.646	.159

using beta weights derived from the West Coast sample data yielded a multiple correlation of .956. In all cases the multiple R's were highly significant.

DISCUSSION

The results of this investigation confirm previous findings that a small set of procedures and skills can be isolated which are highly predictive of flight ability as estimated by the final RAG grade. As the data indicate, those items selected in the East Coast sample were also found to be highly predictive of performance for the West Coast sample. However, some differences did emerge across the two squadrons. The major disagreement appears to be in the relationship of the FMLP/CQ items to the criterion. This may in part result from

the fact that carrier qualifications had been eliminated from a sizeable percentage of the pilots within the sample. As a result, there were instances in which only the FMLP data were included.

Despite these discrepancies, it is highly encouraging to find that reliable predictions can be obtained from only a small subset of the original item pool. In fact these 14 items represent less than 15% of the total set which instructors are required to rate. It is suggested that these represent the most important skills within RAG training, and as a result of their similarity to fleet operations, should be the most reflective of fleet performance. On the basis of these findings a rating form was developed for the purpose of assessing such performance in fleet squadrons. This rating form, which is contained in Appendix A, not only contained the 14 items common to both East and West Coasts, but also a restricted number of items which were highly predictive of performance in either one of the RAG squadrons. In so doing it was hoped that the rating form would contain all possible skill elements of F-4 pilot performance. The usefulness and validity of this form is currently under investigation.

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F-4 FLEET PERFORMANCE RATING FORM

This form is to be used by all F-4 West Coast Squadrons in evaluating the performance of certain selected pilots. The undergraduate and RAG training jackets of these pilots have been thoroughly examined. Now all that remains is a fleet evaluation of these pilots. Hopefully, this will provide a reliable criterion measure against which both graduate and undergraduate pilot performance can be measured. Completed forms will be used as research data only and will have no influence on the careers of the individuals being rated.

This form was developed by analyzing the RAG training jackets of replacement pilots in VF-101 and VF-121. Items within each stage of training were included on this form which were highly predictive of the final RAG grade, and consequently the best discriminators among replacement pilot's flight ability.

This form should be completed by the Squadron Commanding Officer, or a designated individual who is best knowledgeable concerning a particular pilot's flight performance. There are 17 items to be rated on a 7-point scale. This scale is based on a pilot's relative standing among other F-4 pilots throughout the entire community. The percentages listed beneath the scale points indicate what proportion of pilots should fall within each of these categories for the entire community. The pilots you will be asked to rate will not necessarily conform to these percentages. Clearly, not everyone can be outstanding and rated in the top 5% of his group. Likewise, it is possible for an individual to be within the bottom 5% of his group and still be an acceptable pilot with respect to flying ability.

Additional comments concerning performance, flight mishaps, or other flight difficulties should be noted in the space provided. Space is also provided for suggestions/comments which are pertinent to the content and construction of the rating form itself.

Completed forms should be mailed in the pre-addressed envelopes to: Officer in Charge, Code L5, Naval Aerospace Medical Research Laboratory, Naval Aerospace Medical Institute, Naval Aerospace and Regional Medical Center, Pensacola, Florida, 32512.

Are there any suggestions/comments concerning the content or the construction of this rating form? _____

NAME _____ SQUADRON _____ FILE NUMBER _____

	Relative Position Compared With Other F-4 Pilots						
	Acceptable			Good			Outstanding
	1	2	3	4	5	6	7
	5%	10%	20%	30%	20%	10%	5%
A. How well does this pilot rate on the items listed below compared with other pilots in the F-4 community?	(Circle one "X" for each item)						
1. General							
A. Basic Airwork/Aircraft Handling	X	X	X	X	X	X	X
B. Headwork	X	X	X	X	X	X	X
C. Formation (inflight refueling, tactical, enroute, takeoff, landing)	X	X	X	X	X	X	X
D. Tactical Aggressiveness	X	X	X	X	X	X	X
E. Crew Coordination (commentary, teamwork, command response)	X	X	X	X	X	X	X
2. Landings--Carrier/Field							
A. Glide Slope Control (power/nose control, speed control, scan, line-up)	X	X	X	X	X	X	X
B. Landing/Landing Roll-Out	X	X	X	X	X	X	X
3. Instruments							
A. Departure	X	X	X	X	X	X	X
B. Penetration/Approach	X	X	X	X	X	X	X
4. Conventional Weapons							
A. Bomb Pattern/Dive Parameters (dive angle, roll-in airspeed, release, pull-out)	X	X	X	X	X	X	X
B. Overall Accuracy	X	X	X	X	X	X	X
5. Weapons Systems							
A. Flying Technique (altitude/heading/airspeed control)	X	X	X	X	X	X	X
B. Radar Intercept	X	X	X	X	X	X	X
6. Tactics							
A. Offensive ACM	X	X	X	X	X	X	X
B. Defensive ACM	X	X	X	X	X	X	X
C. Lookout Doctrine	X	X	X	X	X	X	X
D. Fuel Management	X	X	X	X	X	X	X

B. Has this pilot had any accidents, incidents, boards, or had his "wings" pulled? _____

C. Are there any additional comments concerning this pilot's ability, mental attitude, motivation, or any other pertinent information? _____